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MANSON, MARSDEN ROAD CONDITIONS IN CALIFORNIA





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BY

MARSDEN MANSON, M. Am. Soc. C. E.

WITH DISCUSSION BY

MESSRS. JAMES OWEN, GEORGE W. TILLSON AND MARSDEN MANSON.

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A BRIEF HISTORY OF ROAD CONDITIONS AND LEGISLATION IN CALIFORNIA.*

By Marsden Manson, M. Am. Soc. C. E.

WITH DISCUSSION BY MESSRS. JAMES OWEN, GEORGE W. TILLSON AND MARSDEN MANSON.

"The good roads agitation," which forced itself upon the people of the United States a decade or more ago, took definite shape in California in 1895. For several years previous, highways were the subject of earnest consideration by organized official and semi-official bodies and by individuals throughout this state. The most important and influential of these bodies was a road convention, held in Sacramento in 1894, which was inaugurated by the Sacramento Society for the Prevention of Cruelty to Animals, and was attended by delegates from various public and quasi-public organizations, and by individuals.

The result of the discussions throughout the state, and notably of the convention above mentioned, was a law,† approved March 27th, 1895, creating a Bureau of Highways for two years.

This law required the appointment of three commissioners, who were to make a broad and exhaustive study: First, of the laws apper-

^{*} Presented at the meeting of April 2d, 1902.

[†] Statutes, California, 1895.

taining to highways in this and other states; second, of the physical features of the state and their relation to a system of roads; third, of the economic and legal status of the highway conditions in each county in the state; and finally, to make a presentation, of the facts and conclusions reached, in the form of a report, commending such measures as the Bureau deemed advisable. The law also required that one or more members of the Bureau, during each of the two years of its existence, should visit each county in the state, and hold public meetings for the consideration and discussion of matters pertaining to highway improvement. To carry out the provisions of this law, an appropriation of \$31 000 was made.

The area over which these duties were to extend embraces some 153 600 sq. miles. It confronts the Pacific Ocean along a coast line more than 1 000 miles in length, between the 42d and 32d parallels of north latitude, and lies between the 114th and 124th meridians of west longitude, extending through 9½° of latitude and 10° of longitude. This area, if laid out upon the Atlantic Seaboard, would cover the territory from New York City to Savannah, or nearly the area of one-fourth of the original thirteen states. If laid out upon the European and African Coast, in corresponding latitudes, it would reach from Valladolid, in Spain, across the Mediterranean Sea to Morocco, the capital of the country of the same name, in Africa.

These comparative areas are shown on the accompanying maps, Figs. 1 and 2, which convey an idea of the extent of the country over which the work was to extend.

Configuration.

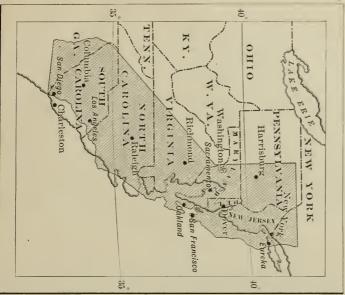
The area under consideration is principally mountain and rolling land of great diversity of features. Two ranges of mountains traverse it from northwest to southeast—the Sierra Nevada in the eastern, and the Coast Range in the western part of the state. The mean elevation of the crest of the former is about 8 000 ft., and that of the latter about 3 000 ft. Besides the numerous valleys contained between their spurs and lateral ranges, their foot-hills enclose the great central valley of California. The area of this valley is about the same as that of the valley of the Po; the average dimensions of that portion which is below the 400-ft. contour above sea level being 400 miles long and 40 miles wide. Tehachapi Pass, at the extreme southern end, and

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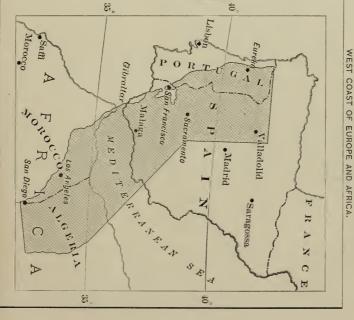
Fig. 1.

Fig. 2.

HISTORY OF ROAD CONDITIONS IN CALIFORNIA.



SKETCH MAP, SHOWING THE RELATIVE SIZE AND LATITUDE OF CALIFORNIA COMPARED WITH THE EAST COAST OF THE UNITED STATES.



SKETCH MAP, SHOWING THE RELATIVE SIZE AND LATITUDE OF CALIFORNIA COMPARED WITH THE WEST COAST OF FUROPF AND AFRICA.

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Acme Summit, at the base of Mt. Shasta, are important entrances into the great valley. The Sacramento and San Joaquin Rivers, and their tributaries, water and drain the valley; their combined watersheds embrace an area of 58 100 sq. miles, situated principally upon the western slope of the Sierra Nevada and the eastern slope of the Coast Range. The edges of this water-shed are the crests of the two ranges of mountains, except an area extending into Oregon in the drainage basin of Goose Lake, which lake when full drains into Pitt River, one of the main tributaries of the Sacramento. The eastern crest rises from 6 800 to 15 000 ft., and the western crest rises from a single tide-level gap at Carquinez Straits to elevations of 900 to 9 000 ft. The gaps in these mountain ranges, and the ridge and valley lines subdividing and lying between them, constitute controlling features in the development of a road system.

CLIMATE.

In variety of climate, the area under consideration presents a wider range than do both the comparative areas just described. Besides the climatic variations, due to difference of latitude or distance from the sea, California presents a wide range of temperature, due to differences in elevation. These differences extend from the arctic temperatures of 15 000 ft. above, to the semi-torrid climate of areas 400 ft. below, sea Between these extremes every grade of temperature and exposure exists. In the hotter portions, fruits and vegetables grow without intermission during the entire year; while upon the colder heights frosts form in midsummer, and only the hardiest boreal plant life exists. Severe frosts and freezing are limited to the most elevated parts of the state. In the greater portion of the higher mountains snow falls before severe freezing weather occurs, and remains until the warm weather of spring, thus protecting from frost action the roadbeds in these regions; and hence no great precautions are necessary to resist its injurious action upon roads.

RAINFALL.

California occupies a position between the north temperate and the equatorial rain belts. The northern part of the state is just within reach of the summer rains of the north temperature rain belt; and the mountains of the extreme southern part of the state are frequently reached by the "Sonora rains," which extend in summer over Northern Mexico and into Arizona, and which originate in the equatorial rain belt. The winter rains of the entire state are principally dependent upon the southern extension of the north temperate rain belt as that hemisphere is turned away from solar energy. Therefore the state has winter rains, and enjoys a comparatively rainless summer.

The mean annual precipitation in the northwestern part of the state and upon the exposed flanks of the Sierras and Coast Range is 70 to 80 ins.; while in the southeastern portion of the state there are comparatively rainless areas, receiving from 2 to 4 ins. annually. Between these two extremes, again, there lies every degree of annual moisture. This precipitation, however, is rarely so heavy that a properly located, well-surfaced, and well-drained roadbed will be badly washed.

VEGETATION.

The distribution and variety of vegetation over an area of such extreme range of climatic and moisture conditions are also of wide range, both in species and density. The forest growth is sometimes so dense that more than 1 000 000 ft. of lumber can be cut from a single acre, but in the drier portions of the state it is difficult or impossible to get shade trees to grow, and other areas are absolutely devoid of vegetation. In the densely timbered areas, clearing and grubbing are expensive, and the shading of the roadway causes it to remain wet longer than is desirable.

NATURAL RESOURCES.

Besides these physical features which have to be considered, there are four belts of natural resources which have controlled the time, locus, and mode of development of certain industries. These directly influence a road system, and determine controlling points of population and trade.

In progression eastwardly, and in order of development, these are: First.—The mineral belt, commencing in Del Norte County, and reaching southeastwardly through the entire limits of the state;

Second.—The agricultural belt of 16 000 sq. miles of fertile land, in the Valley of California;

Third.—The timber belt, commencing in the northwesterly corner of the state, and extending southeastwardly to the Golden Gate;

Fourth.—The fruit belt, commencing at the base of Mt. St. Helena, and extending southerly to the national boundary.

Each of these belts is interspersed with sources of wealth other than those which characterize it; as, for instance, the Sierra timber belt which lies east of and along the mineral deposits on the flanks of the Sierras, and the foot-hill fruit belt at their base. The foregoing classification, however, marks the predominant natural wealth of each of the various sections.

At advantageous points along each of these belts, centers of population are growing up. The problem of laying out the lines of communication which must for all time control the travel and traffic of the state, therefore, must be subservient to two great controlling factors: First, these roads must lie along those lines, determined by Nature, which offer the best grades and alignments, second, they must subserve the economic purposes demanded in the development of the state.

OCCURRENCE OF ROAD-BUILDING MATERIALS.

The Department of Highways extended the work of investigating the various materials suitable for road surfacing, and these investigations showed that there is an abundance of materials over the entire state which can be utilized with great benefit to economic road maintenance. In almost every county adequate materials exist, which, if utilized with skill and judgment, will make good metal. The failures to utilize these materials have been due in part to a lack of knowledge as to their character, and of technical skill as to the mode of using them.

All hard, silicious rocks, such as chert, jasper, quartz, quartzite, etc., the volcanic rocks (trap and basalt), and a wide series of metamorphic rocks occur abundantly. In addition, bowlders, cobbles and gravel of miscellaneous composition, but exceedingly hard and durable, are scattered over great areas. Hard limestone and some of the silicious shales occur in many counties. Occurring with these rocks are others which are inferior or useless for road surfacing. Many instances of failure in the use of rock have been due to the selection of the wrong material. Again, the proper selection has been made, but the materials have not been properly utilized. The best rock roughly cracked up and dumped over a road will no more make a road surface than shingles dumped on a shed and scattered with a take will make a roof.

The best rock must be selected, properly crushed and screened, and then spread, sprinkled, and rolled in layers over a well-graded and drained surface. In one county, an excellent binding material, a soft limestone, was found. It was being hauled a considerable distance, and used almost alongside of the hardest and most durable chert, with which a small proportion of the limestone should have been used as a binding or cementing material. This would have given a better and more durable road surface and saved the long haul from the limestone quarry of nine-tenths of the stone used.

Legal Considerations.

In addition to the physical conditions, there are others imposed by the administration of the law in the various political divisions of the state. The state is divided into fifty-seven counties, which range in area from the 20 000 sq. miles of San Bernardino County to the 43 sq. miles of San Francisco County; and in taxable wealth from the \$400 000 000 of this latter county to the \$260 000 of Alpine County. Furthermore, these counties are divided by law into fifty-three "classes," in each of which material variations are presented in the number, compensation and duties of county officers.

The entire matter of road-building and maintenance has been in the hands of the Boards of Supervisors of these counties, or in the charge of Road Overseers, elected in the road districts into which the counties were subdivided. The abuses incident to the latter control were so great that the roads were placed under the control of the Boards of Supervisors, each member being made Road Commissioner of his district. The control of road funds under Road Overseers became so vital a matter in local politics that at elections the votes for Presidential Elector were sometimes "swapped" for those for Road Overseer.

The laws under which the county officers administer road affairs have been so modified, amended and added to, in the past forty or more years, that they are contradictory and inapplicable. Amendments made to correct difficulties, abuses or even physical conditions, in one portion of the state have made "confusion worse confounded" in other portions. Hence, the exact provisions of the code were not only unascertainable, but in many instances inapplicable, and, furthermore, subject to different interpretations by different officials.

The obstacles to be dealt with are therefore of two classes: (1) physical; (2) political.

Of these, the first can be met by the engineer in almost any form, provided the necessities for overcoming them warrant the raising of the required funds.

The second class, or political obstacles, are so entrenched by custom and control that only long devotion to civic duty by a majority of the voters of a county or state can correct them, and the attack cannot be made successfully until justified by the state of public opinion.

The system of placing county road matters in the hands of a Board of Supervisors, not one of whom is trained for the work, is radically wrong. It happens frequently that members of these boards are faithful, energetic men, who are devoted to the duties of the office, and discharge their obligations to the public with honest efficiency. Many instances of this kind were met by the writer in various parts of the state.

The works of these officials might be considered models, when the obstacles and difficulties under which they were executed were considered. But, unfortunately, this was not the rule. In the majority of instances road moneys were regarded as the funds from which to pay political debts and obligations, or were to be called upon just before elections for the purpose of putting an army of "workers" on the roads where they "would do the most good," not to the roads, but to some candidate.

This absurd and obscure condition of the law and its administration can be understood only when the actual conditions of road management in the entire country, previous to and during that period of its history in which California has developed, are considered; and, without the consideration of these conditions, road mismanagement by an intelligent people is inexplicable. Hence it becomes necessary to review very briefly the modes of road development in the United States since the advent of the railroad.

HISTORICAL NOTES.

In the early part of the century, the prosperity and development succeeding the War of the Revolution required ample and extended means of communication. The common roads of the country were supplemented by toll roads, which were built by companies, on franchises granted for variable periods. These toll roads were frequently built of plank, but were generally of earth and gravel.

The exaction of toll upon these roads became burdensome and restrictive of development; consequently, the acquisition of many of them became a public necessity. From that date to the present we have had it impressed upon us that whenever those utilities which the people should provide and control for themselves have been farmed out to corporations, oppression has resulted—no matter whether the farmed-out franchises were a toll road from Pittsburg to Philadelphia, or a transcontinental railroad to the Pacific Ocean.

The necessities for cheap transportation became so great that the United States Congress, cabinet officers, the President—in fact, almost all the functions of the National, State and County Governments were engaged in the study and practical application of the science of road building. Reports of cabinet officers, messages of the Presidents, and the views of the leading statesmen of our country, bearing on this subject, are very common in Government documents during the early decades of the nineteenth century. Notable among these are:

- 1.—The Act admitting Ohio, in 1802, and setting apart 5% of the sales of public lands as a road construction fund. These sales netted something over \$750 000 in a few years.
- 2.—The bill introduced by Mr. Tracy, of Connecticut, and approved in 1806 by President Jefferson. The debates on this Act show how deeply the road question interested the country.
- 3.—The speech of Mr. Calhoun in favor of placing the bonus on all bonds sold, and dividends of the national banks, in a fund for the construction of roads and canals; this fund would have amounted to nearly \$750 000 annually. This bill, however, was vetoed by President Monroe, in 1817, on the ground that it was unconstitutional, even if the States gave their consent to the provisions of the law.

An extensive system of roads was projected and partly constructed by Congress. The most noted were the "National Turnpikes" in Maryland, Virginia, Pennsylvania and Ohio, which aggregated several hundred miles in length, and received Congressional appropriations amounting to \$7 000 000 in annual appropriations of from \$30 000 to \$500 000.

Finally, in 1834–35, an appropriation of \$300 000 was made for repairing the National roads in Pennsylvania, Maryland and Virginia, and when repaired they were transferred to these states.

Just as road building, fostered by our government and placed in the hands of skilful engineers, became a science, the invention of the locomotive and the consequent development of railroad building came about. At once, all the energies of our people were centered upon this new mode of transportation. So great was the impetus thus given, that the United States soon ran far ahead of other countries in mileage of railroad. For generations the building of roads was forgotten, and the building of railroads stimulated and fostered. The highest skill of the trained engineers of the country has been and is engaged in the general and special work of building, equipping and operating railroads.

During this period of railroad growth and development, roads have been neglected to such an extent that generations have grown up who have never seen a road. They have learned to speak of streaks of dust or mud, as the case may be, as roads—have actually learned to regard them as such, and solemnly dedicate the same to public use, with all due legal form, as if they really were well-located, graded, drained and thoroughly metaled highways. The engineers of the country have so seldom, until lately, been engaged on roadwork that they, too, have looked upon road building as a lost art which at one time was practiced by the ancients.

Under these conditions California was settled, and her laws for road location, construction and management, were framed and developed during a period when road building was at its lowest ebb.

The road system of California, therefore, grew up during a period of general road decadence throughout the entire United States. It has also had a makeshift system grafted upon it from the start. The energies which led the pioneers to traverse a continent in the search for gold was coupled with a love of home which limited their contemplated stay in California to the shortest possible period consistent with the acquirement of wealth. They were, therefore, content with trails, roads and bridges which were essentially temporary or make-

shift in character. Consequently, Californians have learned to regard road building and maintenance as the result of temporary expedients resorted to only when forced by necessity. In some instances, where wise forethought has prompted permanent work and materials, the step has been regarded as an expensive "experiment," and the officials inaugurating these improvements have been accused of extravagance.

It is, therefore, not so much a matter of surprise that the condition of affairs mentioned in the earlier part of this paper grew up along such systemless and extravagant lines.

But the expense of operating bad roads forced a consideration of the methods necessary for correct road location, construction and maintenance. The state had in 1895 reached the limit of development possible under bad roads, and further development was and is yet dependent upon the systematic construction of highways of the most approved type.

Under these necessities, the law of 1895, previously mentioned, was passed.

LEGISLATION.

After two years spent in investigating the subject and in examining the conditions thoughout the state, the Commissioners of the Bureau of Highways recommended minor changes in the then existing laws—principally to harmonize them—and four general laws. These were:

- (1)—An Act to classify the roads of the State into (a) State Highways; (b) County Thoroughfares; (c) District Roads.
- (2)—An Act empowering the State to gradually take charge of, construct and maintain highways of the first class, and making provision therefor, by the levy of a tax of 2½ cents on the \$100 of assessed valuation.
 - (3)—An Act regulating the width of tires.
 - (4)—An Act creating a Department of Highways.
- (5)—An Amendment reducing the maximum rate of road taxation from 40 to 35 cents per \$100 of assessed valuation.

The objects and principles of these laws had been announced and discussed, during the year preceding their introduction, in every county seat and important town, and had met with the general approval of the citizens and the press. Each of the political parties

had put a "plank" in its "platform," looking to the betterment of road conditions, which was supposed to pledge the members of the Legislature to remedial measures.

Of these proposed acts, only one—that regulating the width of tires—became a law. This was drawn to go into effect in 1900. It met with the disapproval of the dealers in and manufacturers of wagons, and at the extra session in 1899–1900 was rendered inoperative.

The law classifying roads was radically changed by the introduction of clauses which would permit of making unimportant roads State Highways, when they could never form the essential parts or links of a great highway system, and would, furthermore, place no limit on the mileage of such additions to the State's obligation. Recognizing the evils of these changes, the Executive withheld his signature.

The bill providing for State construction and maintenance of highways of the first class was amended to entirely alter its purport, and was vetoed by the Governor.

The recommendation to levy $2\frac{1}{2}$ cents on the \$100, for the construction of State Highways, was also radically changed by extracting essential features and incorporating them in another bill, practically placing 85% of that levy to the credit of the counties, to be expended under and by county authorities; also, providing that state officials should indorse bonds issued by the counties, and, in default of the counties paying the interest thereon, that the State should collect and pay such interest. These provisions were contrary to the plain provisions of Article IV, Section 31, of the Constitution, which prohibits the granting of the money or credit of the State to political or other corporations or to persons. These measures failed to become laws, as did the bill previously mentioned.

The bill creating the Department of Highways was amended, for partisan purposes, so as to give patronage in State elections.

The recommendation to reduce the maximum rate of taxation for road purposes from 40 to 35 cents per \$100 was not considered by the Legislature, and, instead of a reduction, the maximum was raised to 62½ cents per \$100 of assessed valuation, by the addition of certain district levies.

An act, constituting Chapter CCLIXIV of the Statutes and Amendments to the Code, 1897, was introduced as an "urgent necessity," and

passed during the last eighteen hours of the session. It was known as the "Clark Road Law." It was never printed or submitted to consideration, and its existence was kept secret from the members of the Bureau of Highways. This law subsequently came before the Supreme Court,* and was declared illegal.

An act intended to provide a connecting link between the roads on either side of the Sierras and between the Yosemite Valley and the basin of Mono Lake was also passed, but, the title being defective, it failed to receive the signature of the Governor.

The Legislature of 1897 also made a conditional appropriation of dimension stone for substructures and of crushed rock for macadamizing the road from Sacramento to Folsom, a distance of about 20 miles. Near this latter point one of the state penitentiaries is situated, and convict labor was to quarry, dress, or crush the rock. The condition of this appropriation of materials was that the county should provide the funds necessary to grade the roadbed, distribute and roll the crushed rock, etc.

This road was to be a model for the state and county officers, who meet biennially at the Capitol.

The work was placed in the hands of a non-technical commission. The members of the Department of Highways undertook to present the matter to the county officials and the people of the county for a bond election. This election resulted very favorably, but the legal provisions and steps were not fully in accordance with the law, and the courts declared the bond issue invalid.

This, in brief, is the history of the first two years' attempt to institute system and economy in road work in California.

The work, however, was continued through a Department of Highways, which took the place of the previous Bureau, and for two years consisted of three members, and thereafter of one member, who was to be appointed for four years.

The Department of Highways thus created continued the work provided for by law, but, by lack of funds, was not permitted to execute any important road work. The members acted in an advisory capacity to County Boards of Supervisors and to County Surveyors. In a few instances opportunities were found to practically advance road building.

^{*} In Davis vs. Whidden, 117 Cal., 618.

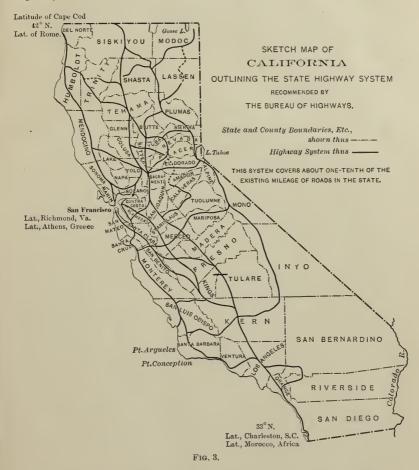
In laying out a system of highways it must be recognized that there are two main principles to be followed. First: The main highways of the state and its counties are lines along which the travel and traffic of an indefinite future must move, and it is therefore necessary to locate these lines on the most advantageous ground, irrespective of temporary private interests, which at most can last for only one or two generations. After roads have been located upon these lines no false economy or makeshift methods should be allowed; the drains, culverts and bridges should be of masonry, the roadbed graded to true lines, and a sprinkling plant provided. Finally, the surface should be metaled with the best available rock. To attempt this upon all roads, with the entire road fund of each county, is not practicable. Existing roads, however bad, must be maintained so as to permit of reasonable use, even if this use temporarily entails heavy loss.

The second principle is that true economy shall characterize the expenditure of available funds. The existing roads must be kept in that state of repair which will enable them to meet the requirements of travel and transportation, and, in addition, a gradual change to proper locations, and the substitution of permanent structures for makeshift and perishable ones, must be made.

It was recommended, therefore, that one-half of the road funds of each county be set aside as a "Good Roads Fund," to be used as the necessities of the county might dictate. With the remaining half of the road funds, it is entirely possible to maintain existing roads in as good condition as they have been for some years past. Particularly is this possible, if wasteful methods and political favoritism be set aside, and system and economy instituted. Should this measure reduce the funds below the requirements of special local interests, the Board of Supervisors has it in its power to levy for this purpose the special tax provided in Section 38, Chapter CCLXXVII of the Statutes and Amendments of 1897. The setting aside of a portion of these funds for permanent work was intended as a means of bringing about system and economy. This, however, cannot be accomplished by law alone. It is imperatively necessary that there should be integrity, technical intelligence, and energy on the part of the officials charged with the disbursement of road funds.

The construction and maintenance of bridges was found to be particularly costly in all except two counties. In one the cost had been

reduced by placing the entire matter of bridge building in the hands of the County Surveyor, an engineer of high skill and integrity. In the other it was realized that masonry was far cheaper than steel, iron and wood. The results of these two examples were freely used by the Highway Commissioners, and the lessons were not wholly lost.



The prime reasons why bridge building and maintenance are so costly are: First, in many instances the bridges are expensive because the county officials do not know the actual cost of materials and labor; and, secondly, a lack of technical knowledge in the matter permits the use of the wrong materials.

Bridges, which should be masonry, are built of very perishable timber, the constant renewals of which exhaust the road funds.

The raising of about \$2 000 000 per year for highway purposes is equivalent to a tax levy of 20 cents per \$100 on \$1 000 000 000. This amounts to \$80 000 000 in forty years, which sum, intelligently and honestly expended, would give California a magnificent system of highways; but it requires the introduction of system, skill, and integrity in every detail, and, if the present system be continued, the full benefit of the expenditure of this vast sum will fall short of being realized.

At the next session of the Legislature, in January, 1899, the Department of Highways renewed the recommendations previously made, and added an important amendment, looking to the creation of a good roads fund in every county, but leaving its control under county authorities. This control, as previously outlined, is considered a very essential part of the political patronage of members of the several Boards of Supervisors, and they generally regard any attempt to put road matters on better lines as an interference with their prerogatives and rights. This amendment apportions 50% of all road moneys for the construction of permanent work in a specified order. Considering that the gross annual expenditures by counties aggregate about \$2 000 000, this "good roads fund," in a few decades of systematic work, would accomplish much good.

These laws and amendments are appended herein in full. They are not intended to be radical or to subvert the method of road administration, but are designed to introduce system and economy, and to correct gradually the abuses and lack of business methods which had grown to be a part of road administration.

AN ACT TO CLASSIFY THE ROADS IN THE STATE OF CALIFORNIA, AND TO DEFINE EACH CLASS.

The People of the State of California, represented by Senate and Assembly, do enact as follows:

Section 1.—The roads within the limits of the State of California shall hereafter be classified as follows:

The first class to include all highways designated as State Highways; the second to include all highways designated as County Thoroughfares; and the third class to include all highways designated as District Roads.

Section 2.—The following roads, when definitely located by the Department of Highways, are hereby declared to belong to the first class.

- 1. A highway commencing on the State line between the State of California and the State of Oregon, at or near the point where the said State line is intersected by the road from Yreka, California, to Ashland, Oregon, and extending thence southerly, along the best grades and alignments, through the Counties of Siskiyou, Shasta, Tehama, Butte, Yuba, Sutter, Sacramento, San Joaquin, Stanislaus, Merced, Madera, Fresno, Tulare, Los Angeles, Orange and San Diego to Tia Juana, in the last-named county.
- 2. A highway commencing at Crescent City, in Del Norte County, and extending south and southeasterly, on the best grades and alignments, through the Counties of Del Norte, Humboldt, Mendocino, Sonomo, and Marin, to the City of Sausalito.
- 3: A highway commencing in the City and County of San Francisco and extending thence southeasterly, on the best grades and alignments, through the Counties of San Mateo, Santa Clara, San Benito, Monterey, San Luis Obispo, Santa Barbara, Ventura and Los Angeles to the City of Los Angeles.
- 4. A highway commencing at a point upon the State Highway through Tehama County, at or near the station of Tehama, and extending thence southerly, on the best grades and alignments, through the Counties of Tehama, Glenn, Colusa, Yolo and Solano, to the City of Vallejo.
- 5. A highway commencing at the City of Martinez, and extending thence southerly, on the best grades and alignments, through the Counties of Contra Costa, Alameda, San Joaquin, Stanislaus, Merced, Fresno, Kings and Kern to a point on the State Highway at or near the City of Bakersfield.
- 6. A highway commencing at a point upon the State Highway through Siskiyou County, near the westerly base of Mount Shasta, and extending thence southerly, on the best grades and alignments, through the Counties of Siskiyou, Shasta, Lassen, Plumas, Sierra, Nevada, Placer, Eldorado, Alpine, Mono, Inyo, and Kern to Indian Wells, in the last-named county.
- 7. A highway commencing at the City of Arcata, in Humboldt County, and extending thence southeasterly, on the best grades and alignments, through the Counties of Humboldt, Trinity and Tehama, to a point on the State Highway through Tehama County, at or near the City of Red Bluff.
- 8. A highway commencing at a point on the State Highway through Shasta County, north of the City of Redding, and extending thence northeasterly, on the best grades and alignments, through the Counties of Shasta, Lassen and Modoc, to Fort Bidwell, in the last-named county.

- 9. A highway commencing at the City of Marysville, and extending thence northerly and northeasterly, on the best grades and alignments, through the Counties of Yuba, Butte, Plumas and Lassen, to Susanville, in the last-named county.
- 10. A highway commencing at the City of Ukiah, and extending thence southerly, on the best grades and alignments, through the Counties of Mendocino, Lake and Yolo, to the City of Sacramento, thence easterly, through the Counties of Sacramento and Eldorado, to a point on the State line between the State of California and the State of Nevada, at or near its intersection by the Lake Tahoe Wagon Road.
- 11. A highway commencing at or near the City of Santa Rosa, and extending thence southeasterly, on the best grades and alignments, through the Counties of Sonomo, Napa and Solano, to Suisun City, in the last-named county.
- 12. A highway commencing at a point on the State Highway running north from Sacramento, and extending thence northeasterly, on the best grades and alignments, through the Counties of Sacramento, Placer, Nevada and Sierra, to a point on the State Highway through Sierra County, near Sierraville, in the last-named county.
- 13. A highway commencing at the City of Oakland, and extending thence easterly, on the best grades and alignments, through the Counties of Alameda and San Joaquin, to a point on the State Highway through San Joaquin County, south of the City of Stockton.
- 14. A highway commencing at the City of Oakland, and running thence northerly and easterly, on the best grades and alignments, through the Counties of Alameda and Contra Costa, to the City of Martinez.
- 15. A highway commencing at Ione, Amador County, and extending thence easterly, on the best grades and alignments, through Amador, Calaveras, Tuolumne and Mariposa Counties, to the county seat of the last-named county.
- 16. A highway commencing at a point on the State Highway through Santa Clara County, at or near the City of Gilroy, and extending thence northeasterly, on the best grades and alignments, through the Counties of Santa Clara, San Benito, Merced, Mariposa, Tuolumne and Mono, to a point on the State Highway through the lastnamed county, near Mono Lake.
- 17. A highway commencing at a point on the State Highway through Santa Clara County, at or near the City of Gilroy, and extending thence northeasterly and easterly, on the best grades and alignments, through the Counties of Santa Clara, San Benito and Fresno, to the City of Fresno.
- 18. A highway commening at the City of Modesto and extending thence northeasterly, on the best grades and alignments, through the Counties of Stanislaus and Tuolumne, to the City of Sonora.

- 19. A highway commencing at or near the City of Hollister, and extending thence southeasterly, on the best grades and alignments, through the Counties of San Benito and Fresno to a point on the westerly State Highway through the last-named county, near Huron.
- 20. A highway commencing at a point on the State Highway through San Luis Obispo County, at or near San Miguel, and extending thence easterly, on the best grades and alignments, through the Counties of San Luis Obispo and Kern, to a point on the westerly State Highway in the last-named county.
- 21. A highway commencing at Port Hartford, in San Luis Obispo County, and extending thence southeasterly and northeasterly, on the best grades and alignments, through the Counties of San Luis Obispo, Santa Barbara and Kern to Indian Wells, in the last-named county.
- 22. A highway commencing at the City of Los Angeles and extending thence easterly, on the best grades and alignments, through the Counties of Los Angeles and San Bernardino, to the City of Bernardino; thence southwesterly, on the best grades and alignments, through the Counties of San Bernardino, Riverside and Orange, to the City of Santa Ana, in Orange County.
- 23. A highway commencing at a point on the State Highway through Shasta County, north of the City of Redding, and extending thence northwesterly, on the best grades and alignments, through the Counties of Shasta and Trinity, to Weaverville, in the last-named county.
- 24. A highway commencing at Colusa, and extending thence westerly, on the best grades and alignments, through the County of Colusa, to a point on the State Highway through said county.
- 25. A highway commencing at Markleeville, and extending thence easterly, on the best grades and alignments, to a point on the State Highway through Alpine County.
- 26. A highway commencing at Mariposa, and extending thence northwesterly, on the best grades and alignments, to a point on the State Highway through Mariposa County.
- 27. A highway commencing at the City of Visalia and extending thence westerly, on the best grades and alignments, through the Counties of Tulare and Kings, to the City of Hanford, in Kings County.
- 28. A highway commencing at a point on the State Highway through Alameda County, at or near Niles, and extending thence southerly, on the best grades and alignments, through Alameda and Santa Cruz Counties to the City of San José; thence southwesterly, on the best grades and alignments, through the Counties of Santa Cruz and Santa Clara, to a point on the highway through Santa Cruz, near Watsonville.

29. A highway commencing at the City of Sonoro, and extending thence easterly, on the best grades and alignments, through the Counties of Tuolumne and Mono, to a point on the State Highway in the last-named county.

Section 3.—The roads of the second class, or County Thoroughfares, shall be the most important roads in each county, as set apart and so declared by the Boards of Supervisors of the several counties, in discharging which duty they may call upon the Department of Highways, in writing, for such advice and counsel as said Board of Supervisors may desire.

Section 4.—The roads of the third class, or District Roads, shall embrace all existing county roads now recognized and set apart by law, and not enumerated in Sections 2 and 3 of this Act as State Highways or County Thoroughfares, together with such additional roads as may be laid out, in accordance with the laws of the State of California, by the Boards of Supervisors of the several counties.

Section 5.—All Acts or parts of Acts in conflict with the provisions of this Act are hereby repealed.

Section 6.—This Act shall take effect from and after its passage.

The total mileage of roads in the State is about $45\,000$. This classification would put about 10%, or $4\,500$ miles, in the first class, and this mileage would ultimately come under the control of the State, and includes all the roads in which the State may be considered to have a direct interest. The remaining mileage would continue under county supervision and control.

ARTICLE III, SECTION 2643, PAR. 7, POLITICAL CODE, TO BE AMENDED AS FOLLOWS:

Cause the road tax collected each year to be apportioned and kept in separate funds by the County Treasurer, as follows:

Fifty per cent. of all moneys so collected shall be apportioned as now provided by law.

The remaining 50% of taxes so collected shall be apportioned to a fund to be known and designated as the "Good Roads Fund." All money so apportioned to the "Good Roads Fund" must be expended by the Boards of Supervisors of the various counties, in the following manner, and for the purposes hereinafter named, and in no other way, and for no other purpose, to wit:

For laying out, grading, sprinkling, graveling or macadamizing the principal highways of the county, and the purchase of all road machinery necessary for the construction of said highways and main-

tenance of same, and the purchase of water rights, and all necessary property to insure a perfect sprinkling system; for the construction of all substructures necessary to a perfect drainage of a highway or road, all of which substructures shall consist of masonry, concrete, salt-glazed sewer pipe, iron or steel; no lumber or perishable material shall be used, except for bridge flooring, when deemed absolutely necessary.

For better guidance of road construction and the expenditure of moneys in the "Good Roads Fund," the following shall be the order of constructing said highways, and the Boards of Supervisors shall observe this order, so far as possible to do:

First.—The laying out of a highway on the best grades and alignments possible.

Second.—The grading and draining of said highways.

Third.—The construction of permanent substructures.

Fourth.—The establishment of a sprinkling plant for said highways.

Fifth.—The graveling or macadamizing of all such highways.

To perform any work or construct any substructures under this section, the Board of Supervisors to make definite surveys of the proposed work, and to prepare plans, profiles and cross-sections thereof, and to submit the same, with estimate of the amount, or amounts, of work to be done, and the probable cost thereof, and with specifications therefor, duly approved by the Department of Highways of the State of California. The said report shall be prepared in triplicate, one copy to be filed in the Surveyor's office, one in the Department of Highways of said State, and the other to be filed with the Clerk of the Board of Supervisors. The Board, upon receipt of such report, must advertise for bids for the performance of the work specified, as provided in this section. All bidders must be offered opportunity to examine such plans and specifications, and said Board shall award the contract to the lowest responsible bidder, and a copy of the plans and specifications so adopted shall be attached to and become a part of the contract; and the person or corporation to whom the contract is awarded shall be required to execute a bond, to be approved by said Board, for the faithful performance of such contract; provided, that after the submission of the bids as herein provided, the Board of Supervisors being advised by the County Surveyor that the work can be done for a sum less than the lowest responsible bid, it shall then be the privilege to reject all bids, and to order the work done, or structure built, by day's work under the supervision and control of said Surveyor; provided, further, that the Surveyor in such case shall be held personally responsible, under his official bond, to construct the work and furnish material, at a cost not to exceed the amount of the lowest responsible bid received.

The furnishing of all material or machinery for the purpose of this Act shall be done by contract and advertisement for bids in the same manner as far as possible as designated herein for road work.

The Boards of Supervisors shall decide all questions pertaining to this Act by a majority vote of all members of the Board.

The County Surveyor and Department of Highways of the State shall have power to inspect any work or advise as to the efficiency or quality of all materials so purchased by the Board of Supervisors for the purposes of this Act, and, upon the written request by the Surveyor and Department of Highways, any failures to comply with the contract or contracts, or any defects in the character of material furnished, shall be remedied by the contractor, and, in default thereof, the Board shall have power to deduct the value of such failure or defect from the contract price agreed to be paid the contractor.

The Board of Supervisors must employ the County Surveyor to superintend the work contemplated by this Act, and, provided said Surveyor is not a salaried officer, must allow him fair compensation for such service.

The Board of Supervisors shall have power to make partial payments upon all contracts let by virtue of this Act, not to exceed 75% of the work done, when the same shall be certified by the County Surveyor as properly performed.

No contract shall be let in conformity to this Act exceeding the amount of money in the "Good Roads Fund" of any county, or the estimated amount to be paid into said fund during the fiscal year in which said contract is entered into.

Section 2651, Political Code, Amended to read as follows:

The Board of Supervisors must annually set apart, from the property road tax collected from all sources, 50%, to be set aside as provided in Article III, Section 2643, Par. 7, Political Code; 35% of the remainder of said road tax may be set aside for general county road purposes; from which sum so set apart they may direct such amounts to be paid as may be found necessary for such general county road purposes in which the inhabitants of all the districts within the county are more or less interested, or to assist weak or impoverished districts in keeping their roads in repair, to be applied as the said Board may order or direct; provided, that the Boards of Supervisors in the several counties shall have no power to create a debt on any road district in excess of the estimated amount of receipts from said district for the current fiscal year.

AN ACT TO PROVIDE FOR THE ACCEPTANCE OF HIGHWAYS OF THE FIRST CLASS BY THE STATE, AND THE MAINTENANCE OF THE SAME, AND TO MAKE AN APPROPRIATION THEREFOR.

The People of the State of California, Represented in the Senate and Assembly, do enact as follows:

Section 1.—Whenever five or more consecutive miles of highways of the first class, as defined in an Act entitled "An Act to classify the roads in the State of California, and to define each class," shall have been located and constructed within the limits of any county, in conformity with plans and specifications approved by the Department of Highways, the Board of Supervisors of such county may petition the Department of Highways to accept said portion of road and to maintain the same.

Section 2.—Said Department shall thereupon examine said road and certify to the Governor of the State whether or not such location and construction have been in conformity with the plans and specifications therefor, and if in its opinion said roads should be accepted. Should such opinion be favorable, and meet with the approval of the Governor, such road must then be accepted by the Department in the name of the State, and shall thereafter be maintained by the Department of Highways as provided by the law.

Section 3.—An appropriation of \$100 000, or so much thereof as may be necessary, is hereby made for the purposes of carrying out the provisions of this Act during the fiscal years of 1899–1900 and 1900–1901; said fund to be designated as the "State Highway Maintenance Fund."

Section 4.—On or about September 1st, 1900, and biennially thereafter, the Department of Highways must certify to the State Controller the amount necessary to maintain said highways of the first class for the following two fiscal years. The Controller shall include this amount in his estimate of expenditures, and which, when paid into the State Treasury, must be credited to said fund.

Section 5.—The Department of Highways is hereby authorized to advertise for bids, in two newspapers in the county in which the road is situated, for contracts to sprinkle, roll and maintain such State Highways as may be accepted under the provisions of this Act, and for the necessary appliances and machinery for said work. Said Department shall have the power to reject any and all bids, and order the work done by day's labor for an amount less than the lowest responsible bidder, and the Commissioner is responsible on his bond that the work shall be done according to the plans and specifications. Said bids to be filed with the County Clerk of the county in which said highway is situated, and to be opened by the Commissioner of the Department of Highways at the office of said clerk on a day specified in said advertisement for bids.

Section 6.—The money paid into the State Highway Maintenance Fund is hereby appropriated, without reference to fiscal years, for the exclusive purpose of maintaining State Highways. All claims against the State Highway Maintenance Fund must be made by warrants drawn against said fund by the State Controller, in the name of the person or persons rendering the services or furnishing material provided for by this Act, and must be audited and approved by the Commissioner of the Department of Highways and by the State Board of Examiners. The State Controller is hereby directed and authorized to draw said warrants, when so audited and approved, and the State Treasurer is authorized to pay said warrants, to the extent of moneys available therefor.

Section 7.—This Act shall take effect upon and after its passage.

AN ACT TO PROVIDE FOR THE LOCATION, CONSTRUCTION, AND MAINTE-NANCE OF HIGHWAYS, OWNED OR TO BE ACQUIRED BY THE STATE OF CALIFORNIA, BY THE LEVY OF A TAX, AND THE CREATION OF A FUND THEREFOR.

The People of the State of California, Represented in Senate and Assembly, do enact as follows:

Section 1.—There is hereby levied annually, for each fiscal year, an advalorem tax of 2½ cents upon each \$100 of value of the taxable property of the State, which tax should be collected by the several officers charged with the collection of State Taxes, in the same manner and at the same time as other State taxes are collected, upon all classes or any class of property, which tax is for the location, construction, and maintenance of highways owned or to be acquired by the State of California.

Section 2.—The State Board of Equalization, at the time when it annually determines the rate of State taxes to be collected, must, at the same time, declare the levy of said rate of $2\frac{1}{2}$ cents upon each \$100 of value of taxable property, and notify the Auditor and Board of Supervisors of each county thereof.

Section 3.—The moneys collected from said rate, after deducting the proportionate share of expense of collecting from the same, to which other State taxes are subject, must be paid into the State Treasury, and be by the Treasurer converted into a separate fund, hereby created, to be called "The State Highway Fund."

Section 4.—The money paid into said "State Highway Fund" is hereby appropriated, without reference to fiscal years, for the exclusive purposes of locating, constructing, and maintaining the State Highways, and in no case shall any portion thereof be used for the acquisition of title to or rights of way over land or lands, through or

upon which said State Highways may be located. All claims against said "State Highway Fund" must be audited by the Department of Highways, and approved by the State Board of Examiners, and payments shall be made out of said fund only upon warrants drawn against the said "State Highway Fund" by the State Controller, in the name of the person or persons rendering the services or furnishing material provided for in this Act; and the State Treasurer is hereby directed and authorized to pay said warrants.

Section 5.—No more than 8% of the money derived from said "State Highway Fund" shall be expended in any one county of the State in any one fiscal year.

Section 6.—All Acts or parts of Acts in conflict with the provisions of this Act are hereby repealed.

Section 7.—This Act shall take effect and be in force from and after its passage.

Chapter CXVII, Statutes and Amendments, 1897, to be Amended as Follows:

Section 1.—The width of tires for wheels upon wagons or other vehicles to be used upon highways in the State of California shall be, for the following styles of wagons, as follows:

1½ and \S -in. steel or iron axle; 2¾ and 3-in. steel or \ Not less than iron thimble skein axle; 2⅓ and 2¾-in. tubular axle. \ 2½-in. tires. 1¾ and 1⅓-in. steel and iron axle; 3¼-in. steel or iron \ Not less than thimble skein axle; 2⅓-in. tubular axle. \ 3-in. tires.

All other vehicles with an axle greater in size or capacity than those above enumerated shall have tires of not less than 4 ins. in width.

Section 3 to be repealed.

Section 4 to be numbered 3.

Section 5 to be numbered 4.

Sections 8 and 9 of Chapter CCLXXII to be Amended to Read as Follows:

Section 8.—The Department of Highways shall take possession, in the name of the State, and as rapidly as the funds provided therefor will permit, of all roads which have been or may be declared State Highways, and, in cases where the Legislature may define the general direction and route of a State Highway, the Department shall definitely locate the same upon the best grades and alignments, and as closely following the general lines defined by the Legislature, as the topography of the country will permit, and in consonance with the

best interests of the State; and whenever the location of an existing county road, or any portion thereof, is such that it may be properly defined as a State Highway, or a portion thereof, then the location of such county road shall be utilized for said State Highway; provided, that all highways included within the boundaries of the lands of the State institutions, parks or reservations, now governed by bodies specified by law, are hereby expressly excepted from the jurisdiction of said Department.

Section 9.—The Department of Highways shall have power to locate, construct, and maintain State Highways to the extent of the funds available; and to this end advertise for and let all contracts; purchase, equip, and operate the necessary quarries; and acquire such other property necessary for the construction and maintenance of the roads provided for. Whenever it shall become necessary to construct any part of the System of State Highways, as herein provided for, the cost of which exceeds \$500, the Department of Highways must have plans, specifications, and estimates therefor in triplicate, and must advertise for bids for a period of two weeks, in two papers of general circulation, and which shall give the lowest rate for publication, published, one at the point nearest to where the work is to be performed, and one at the State Capitol. Said advertisement shall be in the following form:

Department of Highways, Sacramento, Cal.,, 18...

Sealed bids will be received by the Department of Highways of the State of California, at its office in the State Capitol, Sacramento, until..... o'clock,.....M., 18.., for...in.....county, California.

Plans and specifications for said work are on file in the office of said Department and in the office of the County Clerk of.....County, at, Cal., to which bidders are hereby referred.

[SEAL.]	
	Highway Commissioner.

These recommendations were not fully considered by the Legislature of 1899. This was a year in which a senator was to be elected, which duty so engrossed the time of the Legislature that but little else was thought of.

Time was found, however, to re-enact the law providing for the construction of an important link of road between the easterly end of the roads leading easterly from the Yosemite Valley and those of Mono County on the other side of the Sierra Nevada.

The influence of so-called political considerations gave an instructive instance in the drafting of this Act. The roads to be connected are the Tioga Road and those of Mono County, in the basin of Lake Mono. The Tioga Road has been constructed across the Sierras at an elevation of about 9 500 ft., and into the basin of Mono Lake, at the Tioga Mine. From thence three possible routes exist:

First.—Down the canon of Leevining Creek;

Second.—Northeasterly again over the crest of the Sierras at an elevation of over 10 200 ft., and down the cañon of Mill Creek past a mining settlement at which there are at present concentrated some forty votes;

Third.—To the southeasterly, also over the crest of the Sierras, through Mono Pass, at an elevation of over 10 200 ft., and down Bloody Cañon.

All considerations, economy, shortness of route, lighter grades, freedom from snow, stability of roadbed, suitability of materials, and the best interests of the state, are in favor of the first—the Leevining Creek route.

These facts were fully brought out; yet the legislator who drafted and introduced the bill could not be induced to draw it so as to apply to the best route, but yielded to the importunities of the voters on the Mill Creek route, and drew the bill so that the diversion of the fund to that route could be possible. At this date, it is yet possible that the best of the routes may, through these influences, be abandoned for the worst.*

The attempt to introduce method in road building, however, has not been without result; a much better understanding is had throughout the state, and many practices have been corrected. It must be admitted, however, that political road building so far has had the best of the struggle.

^{*} Since the above was written, the U. S. Commission on Roads in the Yosemite National Park has confirmed the selection of the Leevining Creek route. Pp. 11-14 of Report.

DISCUSSION.

Mr. Owen. James Owen, M. Am. Soc. C. E.—This paper is hardly in the line of a professional topic. It recites the history and conditions of road promotion and road legislation in the State of California, and is very interesting, as it gives the experience through which the State of California has gone, which is, to a large extent, similar to that of other States in the Union, except that in California work is not as far advanced as in the Eastern States.

One of the burdens of Mr. Manson's subject is the cry that many engineers make, viz., the interjection of the political element into road work.

Attention should be called particularly to the clause on page 347, because the speaker has never before seen it in the shape of a legal enactment. If it were in active practice in this section of the United States it would devolve upon the engineer to determine whether a bid was too high, and if it should turn out that the work cost more than he estimated, he would have to pay the difference out of his own pocket. It is a question whether the engineering profession at large would like to have such a practice incorporated in their ethics.

There is one point about the California work that does not seem to be stated by Mr. Manson, and that is, that the State Penitentiary, in the early incipiency of the road work of that state, put up a large stone-cracking plant, and at that time a very advantageous rate was made with the Southern Pacific Railroad to haul the road material to different sections of the state. The state engineer at that time told the speaker that they were hauling road material at a very moderate cost for a distance of over 600 miles. The speaker does not know whether or not that practice is kept up now, but it was a very important procedure. The railroads there felt that highway construction was an adjunct to their business, and offered these inducements to facilitate the further development of road work. The railroads in the East, so far, have not taken that view of the road work, but have always demanded full rates for their mileage, in common with other fields of enterprise.

There is another interesting phase of Californian legislation which differs materially from the practice in the East, and it has a great deal of merit: The law provides that a sum of one-half the road tax shall be reserved for what is called a "good-roads fund," out of which the cost of the road construction is paid. After the road is built it is turned over to the state for maintenance, and the state, under the statute, must provide and appropriate \$100 000, or so much thereof as may be necessary, for the purpose of carrying out the provisions of that act. The practice in the East is entirely different. Where the states have interjected their authority and funds

for the construction of a road, the provision afterward is that the Mr. Owen. local authorities shall pay for the maintenance—that is, as far as the speaker knows—he does not remember exactly the practice now in Massachusetts—whether or not the State Road Commission there provides a fund for the maintenance—but in New York, New Jersey, and the States with which he is cognizant, the local authorities have complete charge of the expenditure for maintenance.

The speaker is inclined to think that that Californian provision is an improvement. The more concentrated the authority of maintenance the better will be the result. The difficulty always found in road construction or road maintenance is, that while people are very anxious to have good roads, and appreciate them, the local authorities are not anxious to appropriate the necessary moneys to keep them in good repair.

George W. Tillson, M. Am. Soc. C. E.—In Toronto, Canada, the Mr. Tillson. practice in receiving bids is somewhat similar to that mentioned in the last clause of the California law. When bids are asked for in Toronto, or rather when they are received, the practice is for the city engineer himself to put in a bid on the work. If that bid is lower than any of the others received, the work is awarded to him and he completes it by day's labor. The object, of course, is not to give the city engineer the opportunity to pay for anything out of his own pocket, but is to prevent the bidders from making a combination and getting more than a reasonable price for the work, because it ought not to be difficult for the contractors to do work at a fair profit, but for less than city officials, in this country, at least, could do it by day's labor.

In looking over the report of the city engineer, where he has reported upon work for which he put in his proposal and was awarded the work, it is found that, as a general rule, he has often done the work for less than the amount of his bid, but in some few cases the cost of the work has exceeded his bid.

In regard to the Massachusetts law, the President of the Commission told the speaker, a short time ago, that at the present time they have charge of the maintenance of the roads, although at first they did not; and that the cost last year averaged \$95 per mile for maintenance, over all the roads, although some of the roads, on which the work was done by contract, were kept in good repair for \$70 per mile.

Marson Manson, M. Am. Soc. C. E. (by letter).—In the applica-Mr. Manson tion of the principles of engineering to the varied problems before that profession, the physical, economic, legal and political phases have to be broadly construed and balanced. When the work or problem has long been treated without any professional consideration whatever, the history of this treatment and its results must enter into the engineering study. The writer does not agree, therefore, with Mr. Owen, that a brief consideration of road history and legislation are

Mr. Manson. not professional topics; they are all elements in the great problem of rectification which, sooner or later, has to be undertaken.

The principles of engineering must not only be applied to re-location, drainage, grading and installing a true highway, but, for considerable periods, must be also applied to the maintenance of the next to impassable surfaces called roads.

The writer overlooked the excellent work done by the rock-crushing plant at the State Penitentiary at Folsom. Mr. Owen, however, was misinformed as to the distances over which its product was distributed. Small quantities were sold to adjacent counties at cost, and transported at very cheap rates to perhaps one-fourth the distance mentioned by Mr. Owen, or about 150 miles as a maximum. The greater part was taken by the cities of Stockton and Sacramento. The plant was destroyed by fire, supposed to have been incendiary, but has been re-established on a diminished scale.

The provision requiring one-half the road funds to be set aside as a Good Roads Fund was one of the recommendations of the Highway Commission; it did not become a law, as Mr. Owen seems to infer. A careful reading of the paper will correct this misapprehension; nor was the recommendation carried out that \$100 000 be appropriated as a Maintenance Fund.

The provision in the Canadian law, mentioned by Mr. Tillson, permitting the engineer to bid in the work and perform the same by day's labor, is an excellent one, as it provides an adequate check on collusion among bidders.

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